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Pesticide Pollution and It's Effects on Environment and Human Health: A Review

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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Review Article

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ABSTRACT

Pesticides are chemical composition that are used to control the pest. The increased usage of pesticides with each passing day, are becoming poisonous for our environment. It causes acute and chronic effects on human health. Pesticides help the farmer for growing more crops into small land with high quality food. Use of other methods of controlling pests such as integrated pest management (IPM) strategies.

Keywords: Overutilization; integrated pest management; analytical; detector; electrophoresis.

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1. INTRODUCTION

Pesticide are a chemical composition that are used to control the pests. These pesticide consists of herbicides, insecticides and fungicides. Generally, pest can be explained as the organisms that threaten our health, food & comfort. Pesticides generate air, water and soil pollution.

1.1 Air Pollution

When pesticide applied into crops lands wind spreads them into the environment, which poses a big risk to wildlife.

1.2 Water Pollution

When pesticides are shower on crop plants, it is capable to runoff below the surface of earth, hold out groundwater, and thus pollute the groundwater & producing an inappropriate cultivation.

1.3 Soil Pollution

Overutilization of pesticides cause soil pollution it affects the soil fertility and natural organisms on land.

2. IT'S USES IN ANCIENT TIMES

Pesticides has been used from 2000 B.C. In ancient Roman times people utilize pesticide by flaming sulfur for killing pests and also used ashes & salt for managing the weeds. In 15th century, poisonous chemical like, mercury, arsenic & lead has been tested to crops to kill pests. In 17th century, USA gardener, use definite chemicals like, nicotine sulphate, calcium arsenate as pesticide. Paul Miller found DDT a very essential insecticide. In 1950-1955 capton & glyodin, fungicide, organophosphate & malathion were introduced. In 1955-1960, triazine herbicide was discovered. In 1960s American Scientist Rachel Carson in his book Silent Spring draw attention towards the environmental damage of biodiversity due to some harmful pesticide. So, in 1972, DDT got completely banned in USA.

3. PESTICIDE CATEGORIZATION

Pesticide can be categorized into different types like insecticide, herbicide, rodenticide, fungicide, nematicide, molluscicide.

On the basis of this method the targeted pesticide work on the targeted pest like insecticide destroy only insects. Insecticides consists of boric acid, malathion, allethrin etc. Same method followed by fungicide results in destroys only fungus. Herbicides are used for weed control.

4. PESTICIDE POLLUTION

When pesticide sprayed on the targeted plants, unwantedly it can disperse to the non-targeted plant through wind which effects it. When pesticide sprayed on the land it can effects other species also that is why, most of the pesticides got banned due to their harmful impacts. Pesticide can participate to air pollution when pesticides are sprayed on plants that time pesticide spots are transfer by the wind to nearby area, which is threat to our wildlife. Some pesticide can stay for a long time in a particular space but some get vanished in a short time. Water pollution is defined as when inappropriate matter are present in water which makes it poisonous. When pesticides are sprinkled into the crops it passes to the ground & hold out the water, through which it pollute the groundwater & making it inappropriate for both human and land use. Overutilization of soil causes soil pollution. Because of some harmful pesticides the organism which rely on the soil get effected by it. Organisms get effected by pesticide their growth, cellular function and reproductive behavior get reduced. Pesticide disturbs the microorganisms balance in the soil.

5. PESTICIDES EFFECTS ON HUMAN HEALTH

Pesticides effects human health by causing an acute (a short term disease) it also cause chronic disease (long lasting disease which is very dangerous).An Acute effects includes rashes, blindness, diarrhea & sometime it cause death. Chronic health effects includes cancer, birth defects etc., Mostly infants and children get effected by pesticides & also the farmers who spray the pesticides they can also get effected by it because they go through this risk. Pesticide get in touch with human body through consumption of food & water, breathing in or out & through skin. Human bodies perform mechanism for excretion of toxins, but in some cases pesticides distributed into the body because its concentration increases more than its original concentration in the environment.

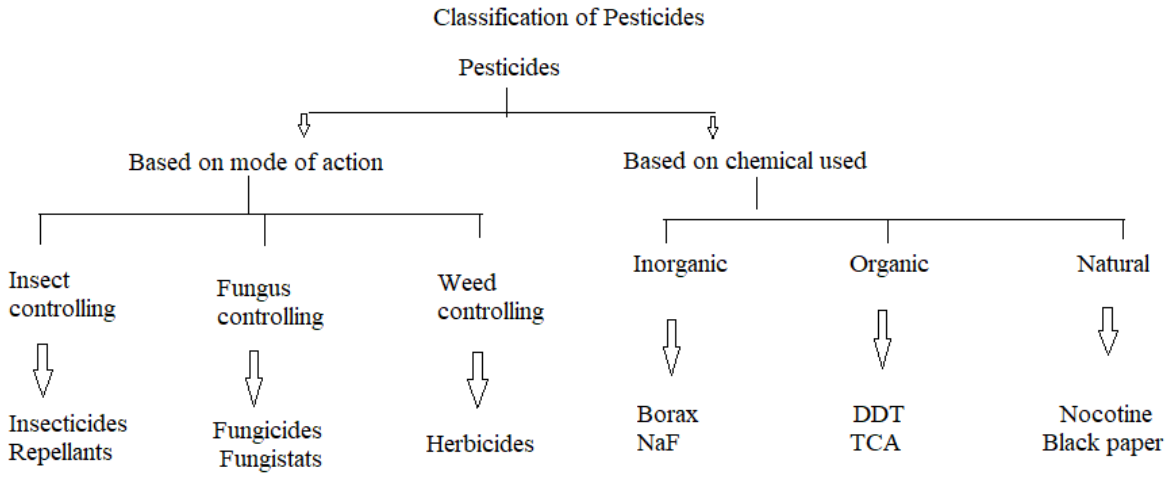

Chart 1. Classification of pesticides

5.1 Acute Effects from Pesticide

Some pesticides like pyrethrin/pyrethroids, organophosphate and carbamate these cause serious response to asthmatic people. It causes headache, abdominal pain, nausea, vomiting, skin itching, dizziness.

5.2 Chronic Effects from Pesticides

It is a long term health effect which include several diseases like cancer, birth defects & damages numerous body organs. It can effect our body for months or year. It causes several effects to reproductive hormone may cause birth defects, abortion, infertility. Organophosphate & Carbamate pesticide causes increasement of neurotransmitter acetylcholine.

5.2.1 Affect of pesticides on environment

It effects terrestrial plants & animals and also aquatic organisms. Pesticide reach the water through runoff, groundwater or by percolation through the soil. When pesticide enter into the aquatic ecosystem the dissolved oxygen decreases into the water which may cause changes in their temperature, their stability, their reproductive behavior. Because of pesticide consumption most of the aquatic organisms get die. Pesticides like atrazine show harmful effect on some fishes & carbaryl pesticide which effect amphibians.

5.2.2 Benefits of pesticides

By killing some pests like bugs, weeds it causes increasement of crops. Pesticides help the farmer for growing more crops into small land with high quality food. Pesticide use to prevent from malaria, Lyme disease & West Nile virus, which occur from rodent & insect vectors.

5.2.3 Disadvantage of pesticide

Many of the flora & fauna species get damage from pesticide. It imbalance the ecosystem. Food chain also shows the adverse effect on animals like grasshopper eats grass in which low concentration of pesticide is present after this grasshopper is eaten by shrew the concentration of pesticide will increase in it. When shrew is eaten by other predator the pesticide concentration will become high in its body. That's how pesticide is killing us.

6. REVIEW OF LITERATURE

6.1 Oskar Karlsson et al. [1]

The study provides important cross species evidence paternal epigenetic inheritance and pollutant induced transgenerational toxicity, supporting a casual and complex role of environmental contamination in the ongoing species extinction particularly of amphibians".

"The present study provide evidence of transgenerational toxicity following environmentally relevant pesticide exposure in amphibians. However a present study constitutes a first and important step to develop a multigenerational AOP for paternally transferred effects of anti-androgen/ anti thyroid chemicals in amphibians by characterizing key events and adverse outcomes over generations following a defined exposure with regards to substances,

exposure levels, mechanism of action and window of exposure".

6.2 Gervas E. Assey, et al. [2]

"The aim of this study was to look into the articles studied on the impacts of pesticide pollution on the environment, ecosystem as well as on human health. The reviewed studies have revealed that there are benefits and risks as well as effects of pesticide pollution on environment".

"The studies have also revealed that in order to control pesticide pollution, the use of other methods of controlling pests such as integrated pest management (IPM) strategies such as biological as well as cultural could be used to control pests instead of chemical pesticides".

6.3 Muyesaier Tudi, et al. [3]

"The review study indicates that agricultural development has a long history in many places around the world. Moreover, pesticide contamination moves away from the targeted plants , resulting in environmental pollution . Such chemical residue impact human health through environmental and food contamination".

"To minimize the negative influence of pesticide contamination on the environment and non-targeted organisms, new scientific methodology and technology and useful measures, such as integrated pest management (IPM), laws that forbid pesticides with high risks, and the development of a national implementation plan (NIP), should be implemented, to reduce the negative effects of pesticides. Biopesticides should also be developed alongside chemical pesticides to minimize pesticide contamination".

6.4 Mohamed A. Hassaan, et al. [4]

"This review provides an analysis of pesticides definition, classification, toxicity, factors affecting toxicity, pesticide in water resources, their environmental fate, impact on human health and their method of detection, disposal and treatment. This work gives a brief description of the extraction method used for pesticide analysis beside comparing the analytical techniques used to measure the very low concentration of pesticide".

"Modern analytical techniques for pesticides are capillary electrophoresis, immunoassay, GC and LC connected to selective detector such as MS/MS and fluorescence that have high sensitivity to measure very low concentration of pesticides".

6.5 Jyoti Kaushal, et al. [5]

"This review emphasize on the toxicological effect of organophosphate pesticide and the recent methods of detection that are used to identify trace amount of organophosphate pesticides along with strategies which are used for their degradation".

"The enzymes that have been till date identified as potential degrading tools for organophosphate pesticides have been engineered such that their activity is enhanced and the degradation is achieved in minimum time with maximum results. Immobilization of two or more such enzymes on a suitable matrix can also degrade more than one compound in a single run of the experiment. Such advancements in the field of science can help in overcoming the problem of organophosphate pollution in the environment if steps are taken at the right time and the studies referred so far are efficiently exploited".

6.6 Elzbieta Wolejko, et al. [6]

The present review summarizes the recent scientific reports regarding soil enzymes and activities of microorganisms as well as change occurring in underground biochemistry under the influence of pesticides. It also investigates pesticide degradation in soil and prevention of their negative effects on soil biological activity.

The use of the methods of genetic engineering and various biotechnological techniques make it possible to analyze how pesticide are biodegraded by microorganisms.

6.7 Anket Sharma, et al. [7]

"In the present manuscript, an attempt has been made to critically review the global usage of different pesticides and their major adverse impacts on ecosystem, which will provide guidance for a wide range of researchers in this area".

"Among different classes of pesticides, organochlorine pesticides are the most harmful one due to their slow rate of decomposition, greater stability and long half line. These pesticides can migrate and get accumulated in the upper trophic levels of food chain. Use of

biopesticides should be encouraged over chemical pesticides".

6.8 Kalpana Gyawali [8]

The reports show that the pesticide use increasing every year globally and currently its national use in average is 0.39kg a. i /ha. Due to its haphazard use in some commodity and ignorance of waiting period after its application has increased the risk of the exposure of farm families to pesticide and intake of pesticides by consumer, which are becoming major health threat.

Taking into consideration the health and environmental effects of chemical pesticides, it is clear that the need for a new concept in agriculture is urgent. This new concept must be based on a drastic reduction in the application of chemical pesticides, which can result in health, environmental, and economic benefits to the public.

6.9 Adolfo Marican et al. [9]

"This review provides a description of older and newer technique and materials developed to remove specific pesticides according to previous classification, which range from bioremediation from microorganisms, clay, activated carbon, and polymer materials to chemical treatment based on oxidation processes".

"The biological process of remediation can involve biological processes using strains of fungi and bacteria capable of degrading pesticides. Within the physical remediation, there are good adsorption materials for pesticides with low cost of production that can be used effectively to treat wastewater containing pesticides. Physiochemical remediation of pesticides is mainly based on the use forms of energy applied to the destruction of these pollutants, with alternatives such as photolysis and ultrasound, the most commonly used. In conclusion, for choosing the best technique and material for removing pesticides, it is extremely important to take into account all the parameters involved, such as pH , type of matrix, temperature, quantity of water and soil, cost of investment, solubility of pesticides, etc".

6.10 Thomas James Wood, et al. [10]

"The purpose of the present paper is to collate and summarize scientific evidence published since 2013 that investigate the impact of neonicotinoids on non-target organisms. Whilst much of the recent works has focused on the impact of neonicotinoids on bees, a growing body of evidence demonstrate that persistent, low levels of neonicotinoids can have negative impacts on a wide range of free living organisms".

"Relative to the risk assessments produced in 2013 for clothianidin, imidacloprid and thiamethoxam which focused on their effects on bees, new research strengthens arguments for the imposition of a moratorium on their use, in particular because it has become evident that they pose significant risks to many non-target organisms, not just bees".

6.11 Baltazar Ndakidemi, et al. [11]

"This review aims at exploring the side effects of synthetic and botanical pesticides on beneficial insects to give the basis for research on the negative impacts of synthetic and botanical pesticides on these insects.

Botanicals are often categorized as safe and environmentally friendly but their use for insect pests control should always be done with caution. More research is therefore needed to determine the side effects of both botanical and synthetic pesticides on predators, parasitoids and pollinators".

6.12 Muhammad Sarwar [12]

The health effects of pesticide depend on the type of pesticide, some chemicals such as the organophosphate and carbamates affect the nervous system, while others may irritate the skin or eyes. Some pesticides may be carcinogens, but others can affect the hormone or endocrine system in the body. One way to minimize exposure to pesticides is to take approaches called Integrated Vector Management (IVM) and Integrated Pest Management (IPM) that are vector and pest control strategies which use a combination of methods to prevent and eliminate problems in the most effective and the least hazardous manner.

Before a pesticides is allowed to be used or sold, it must undergo a rigorous scientific assessment process to ensure that no harm can occur when pesticides are used according to label directions. All pesticides registered in a state, including for agriculture, forestry and domestic uses must undergo this level of scrutiny.

6.13 Merete Grung, et al. [13]

"Our review reveals that the most studied areas in China are the most populated and the most developed economically and that the most frequently pesticides are DDT & HCH. The compound analyzed and reported in the studies represent a serious bias because a great deal of attention is given to DDT & HCH, whereas the organophosphate insecticide dominating current use are less frequently investigated".

"The concentration in biota reveal that a large fraction of the results from the studies are classified as very bad for DDT. Reports were heavily biased towards DDT and HCH. Hence, these pesticide apparently pose the greatest risks. However, this may be biased due to lack of data for other pesticides".

6.14 Ilse Delcour, et al. [14]

"The objective of this review is to gain insights into the specific effect of climate change on the consumer exposure caused by pesticide residue on crops. In terms of climate change, temperature increases and changes in precipitation patterns are the main pest and pathogen infection determinants".

"For farmers, the season and timing of the pesticide application, seasonal precipitation and temperature in relation to environmental factors, will strongly influence management decision. Acc. to Reilly et al. overall climate change will be beneficial to crop productivity, despite the risk at regional levels".

6.15 Wassila Riah, et al. [15]

"Here we review the effects of pesticides on the activity of soil enzymes in terrestrial ecosystems. Pesticide are also impact soil enzymes, which are essential catalyst ruling the quality of soil life".

7. CONCLUSION

To preserve the environment, many of those molecules have been will be withdrawn from the market such as clothianidin, imidacloprid, thiamethoxam and endosulfan. This work has allowed to

(i) Identify patterns of enzymatic activity response to pesticides application.
(ii) Link them with the pesticides mechanisms of action,
(iii) Classify the pesticides according to their stimulating, inhibiting or neutral effects on enzymatic activities
(iv) Bring overall trends face to face with literature related pesticides impacts on microbial contamination.

The case of glyphosate weakens the hypothesis of a potential spread of observation whatever the context. These first patterns of response have to be validated by further studies which may rely on the development of new technologies such as sensitive molecular based approaches for measuring microbial community structure , as well as the use of real time PCR or proteomic approaches to evaluate the expression level of genes involved in key ecological functions. Finally, in this review , we attempt to look for general trends of enzymatic responses to pesticides , which could be useful for researchers and thus for policy decision markers in order to replace agronomy in the center of agriculture.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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